

## Momentum & Impulse

### Momentum, $p$

Think of momentum,  $p$ , as a measure of how hard it is to change an object's velocity or bring it to rest.

- $p = mv$

### Impulse, $J$

Impulse is change in momentum

- $J = m(v_f - v_i)$

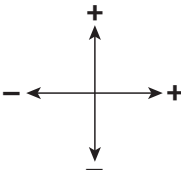
- $J = Ft$

- $Ft = m(v_f - v_i)$

Note that  $m(v_f - v_i)$  is the same as  $m\Delta v$

**Vector Quantities**

Momentum and Impulse are vector quantities; order matters! By convention, **up and right are positive** and **down and left are negative**.



## Collisions and Projectiles

In a collision or the firing of a projectile, the total momentum before the collision or firing is the same as the total momentum afterward.

### Elastic Collisions (Objects bounce)

$$m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$$

### Inelastic Collisions (Objects stick)

$$m_1v_{1i} + m_2v_{2i} = (m_1 + m_2)v_f$$

### Projectiles (Guns, etc.)

$$0 = m_1v_{1f} + m_2v_{2f}$$